OPERATION RESULTS ON SAFETY SYSTEMS OF TRITIUM PROCESS LABORATORY (TPL) IN JAPAN ATOMIC ENERGY RESEARCH INSTITUTE (JAERI)

T. Yamanishi and M. Yamada
Tritium Engineering Laboratory, JAERI

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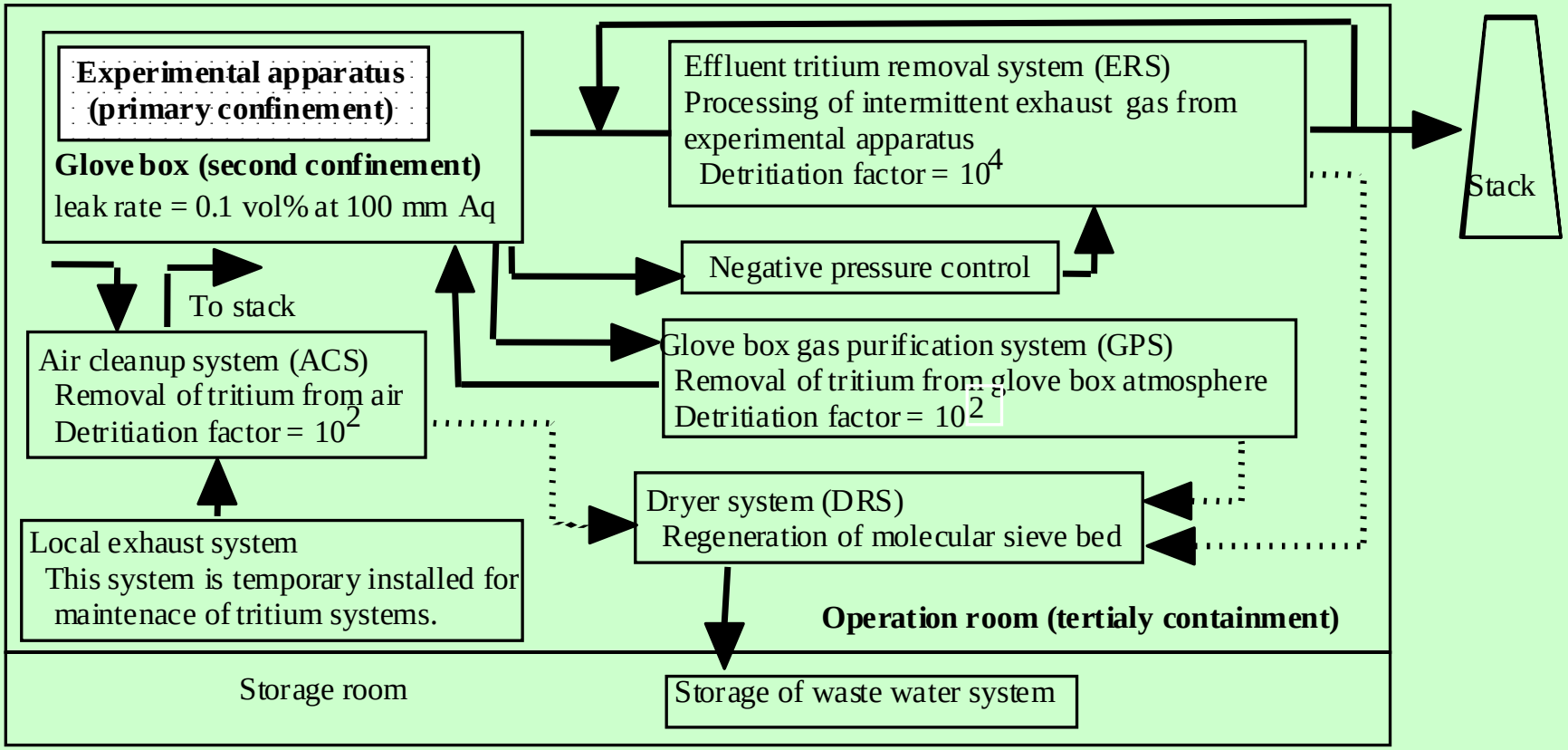
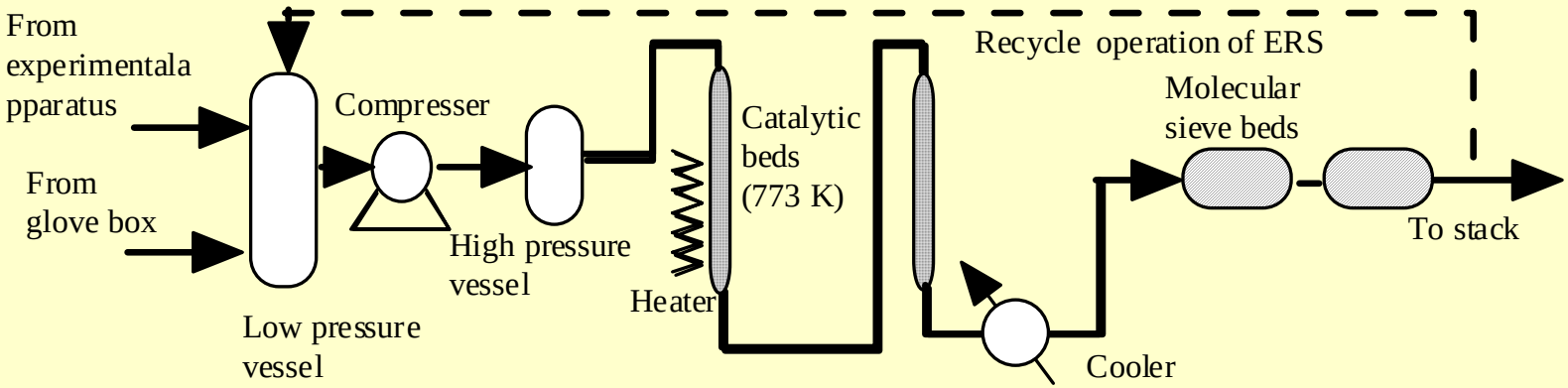
Culham Science Center on April 05 and 06, 2005.



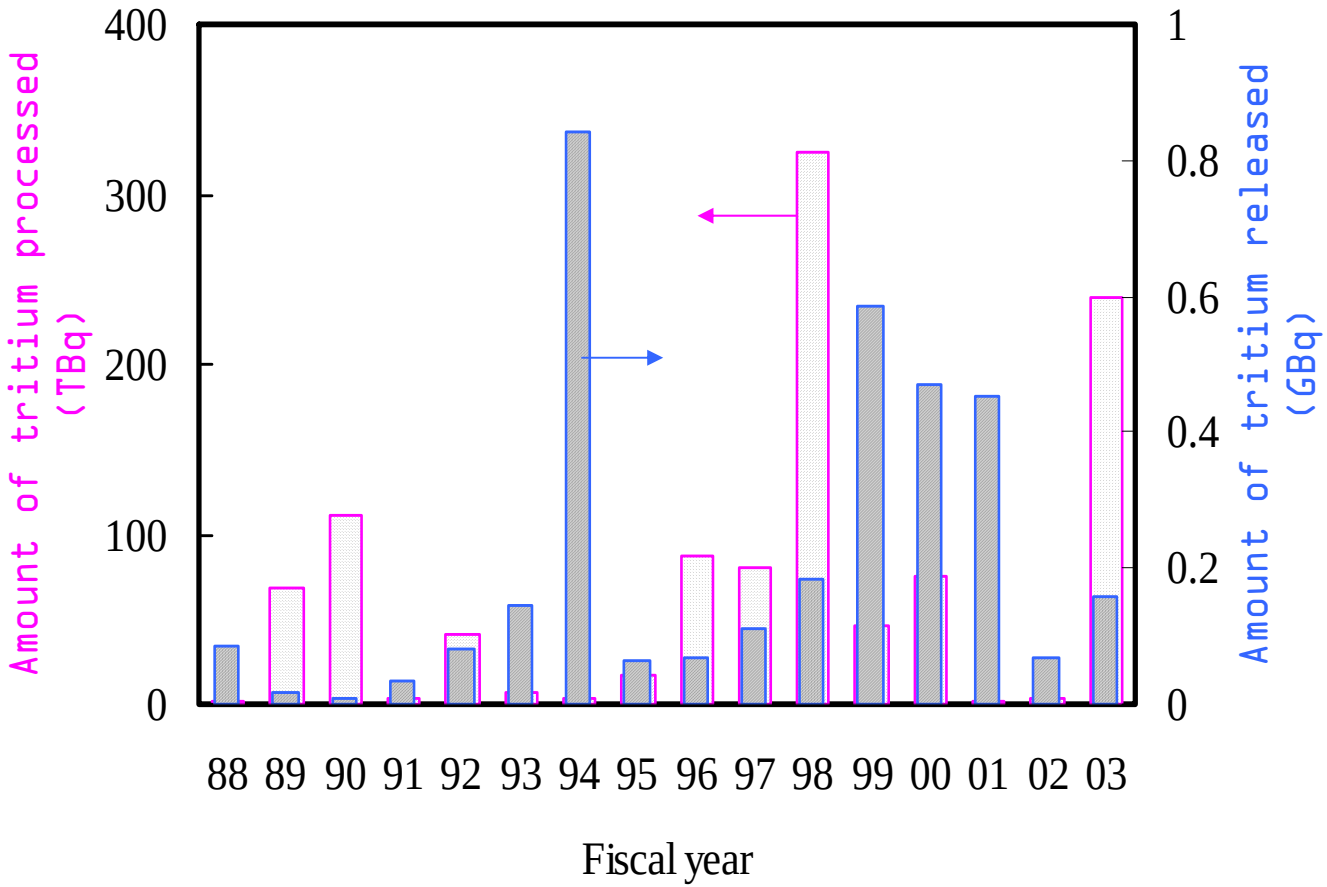
Configuration of safety systems (tritium onfinement and removal) of TPL

The concept of the safety systems at the TPL is triple confinement.
The operation room (leak rate = 1 Vol% at 15 mm Aq) is designed as the tertiary confinement.
A detritiation system is installed for each confinement, ERS, GPS and ACS.



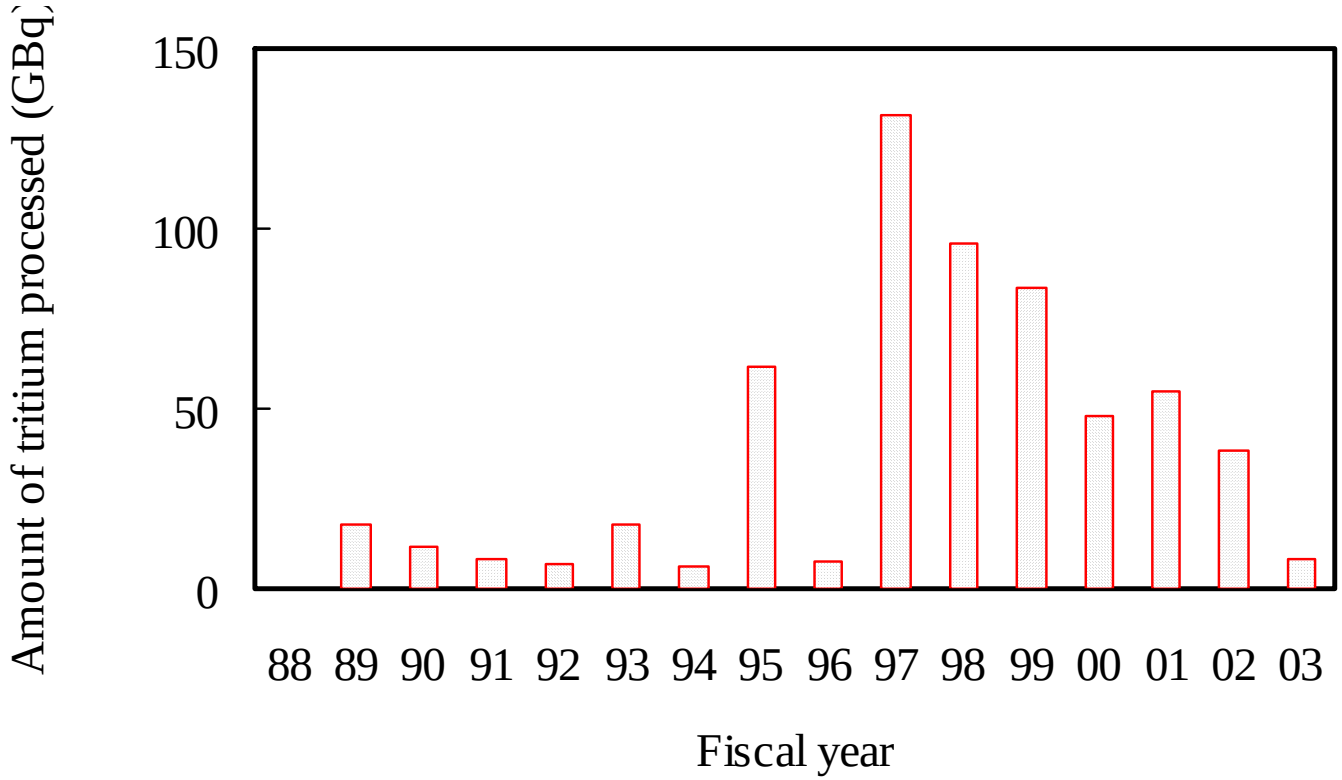
Conceptual flow diagram of ERS at TPL

The gases from the apparatus and glove boxes are stored in a low-pressure vessel (50-70 kPa), and are sent to a high-pressure vessel (700 kPa). The tritium in the gases is removed through two catalytic beds at 773 K and 473 K and two molecular sieve beds. The GPS and ACS are also composed of similar components, although a catalysts bed at 773 K is not equipped.

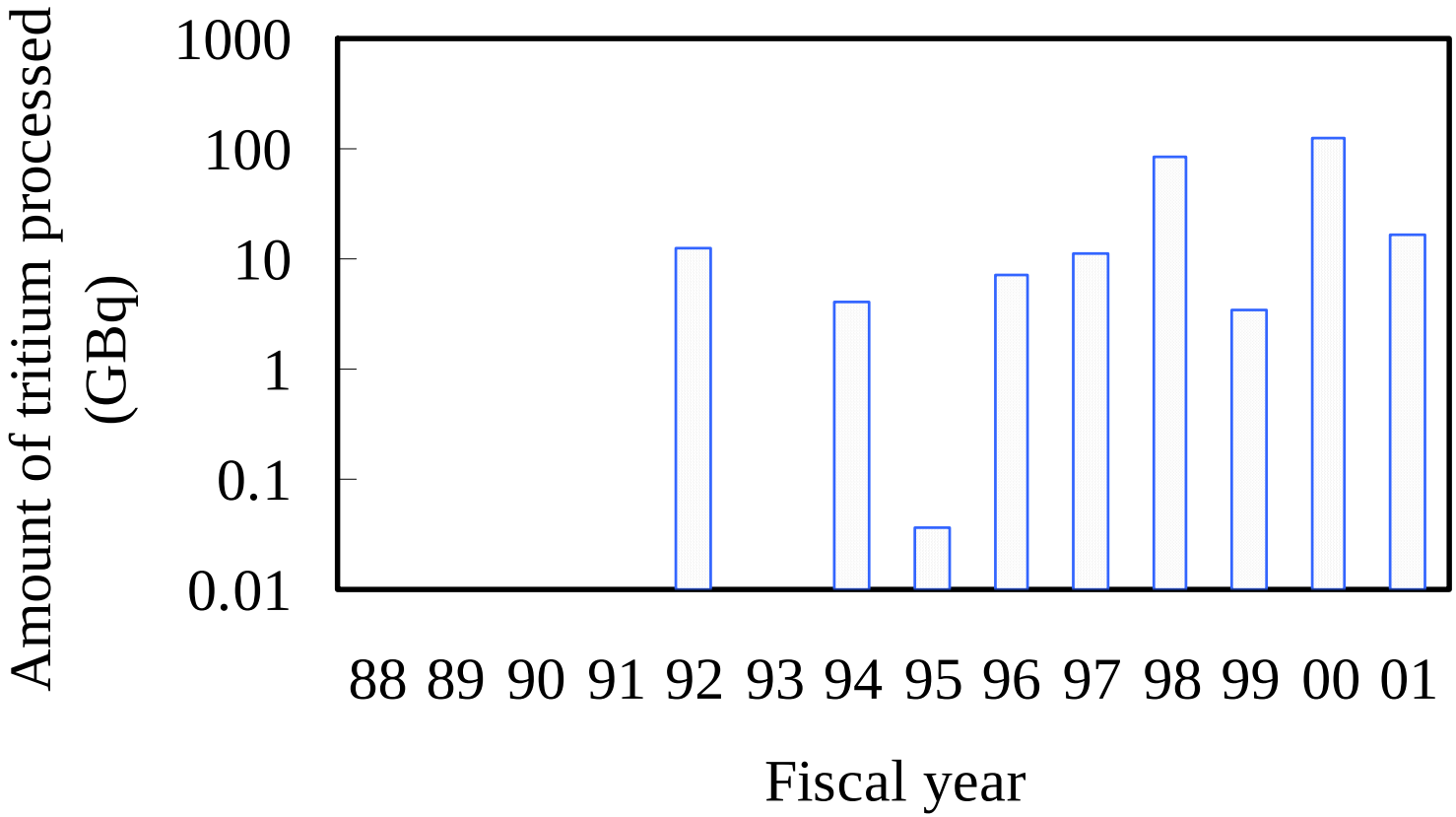


Amount of tritium for each fiscal year processed by ERS and that released from ERS to stack.

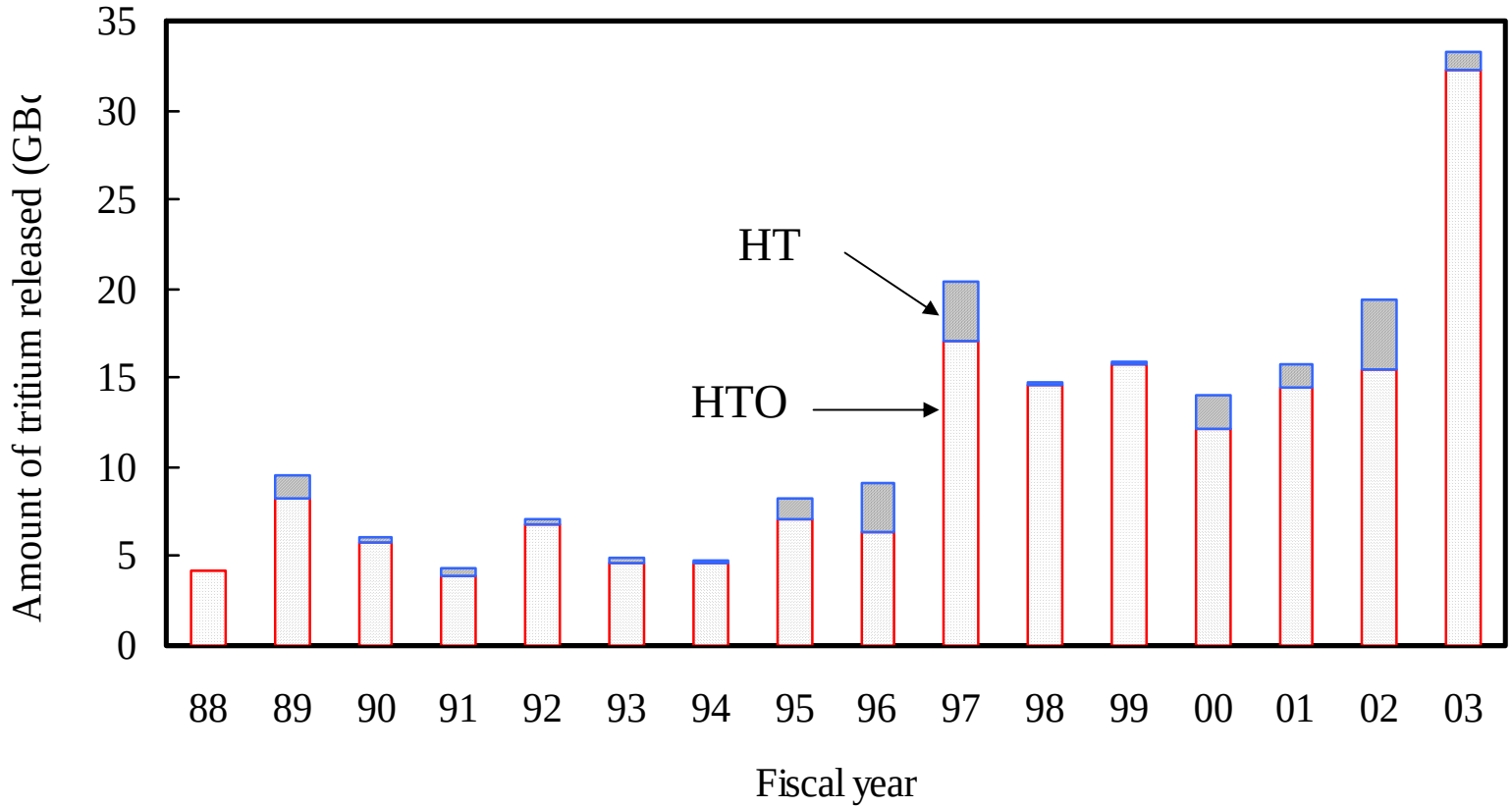
The total amount of tritium released from the ERS to the stack was 3.4×10^9 Bq. The detritiation factor of the ERS is calculated to be 3.3×10^5, which is 33 times larger than its design value.



Amount of tritium processed by GPS through each fiscal year.

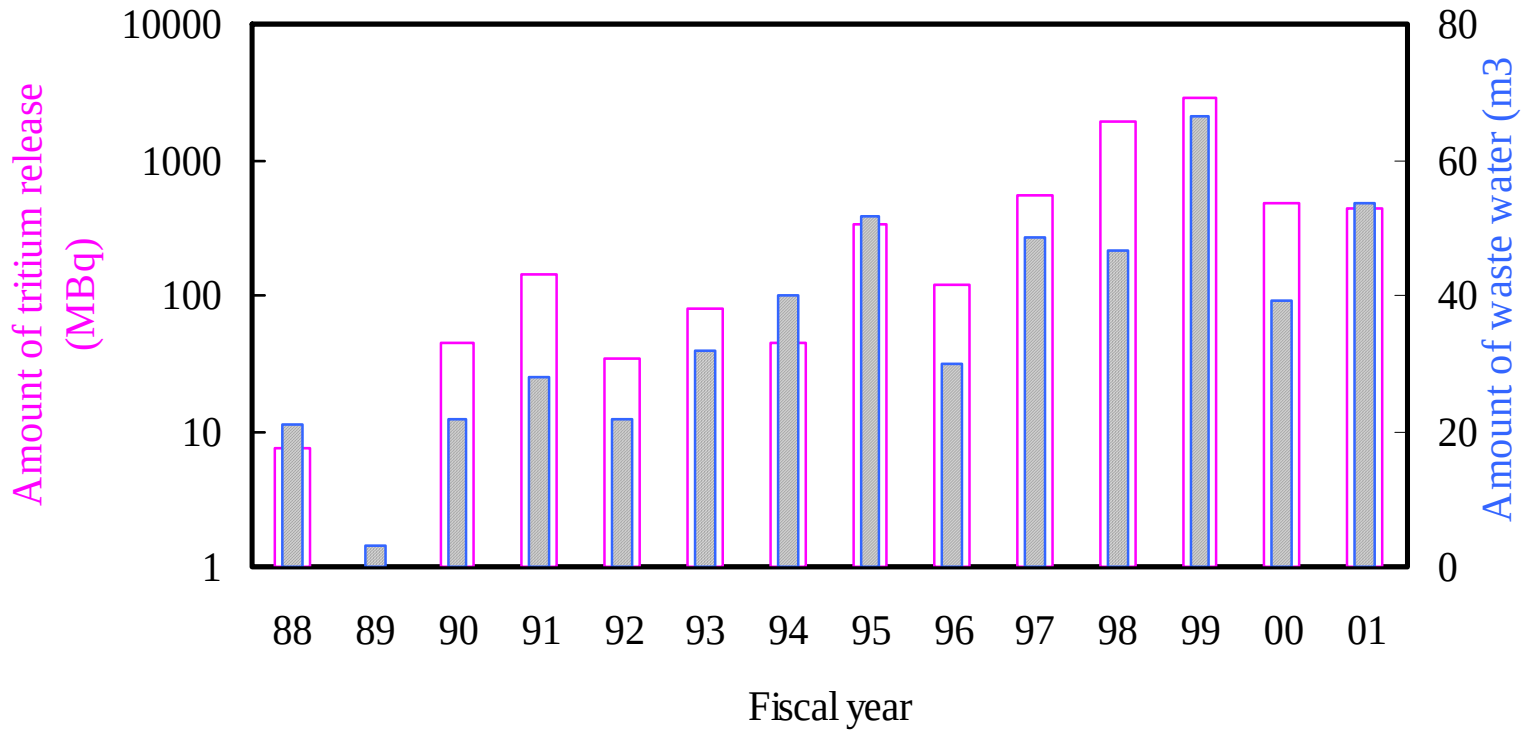


Amount of tritium for each fiscal year processed by ACS for each fiscal year.



Amount of tritium released from stack for each fiscal year.

At the stack, molecular species of tritium (HT and HTO) are separately measured with a tritium monitor and a moisture corrector. The total amount of tritium released from the stack was 1.73×10^{11} Bq (HTO) and 1.8×10^{10} Bq (HT) from April 1988 to March 2004. The flow rate of the gas stream at the stack is 38800 m^3/h, and an average concentration of tritium at the stack was 32 Bq/ m^3.



Amount of tritium released as waste water for each fiscal year.

Frequency of failure of components (From April 1988 to March 2002)

Component	Number	Operation time (h)	Number of failure	Frequency of failure
Blower	5	126296 2389*	9 0	7.1×10^{-5}/hr 0**
Compressor	3	5675 41471*	4 2	7.0×10^{-4}/hr 4.8×10^{-5}**
Sampling pump	19	930337 6150*	6 18	6.4×10^{-6}/hr 2.9×10^{-3}**
Manual valve	307	4298*	3	7.0×10^{-4}**
Air drive valve	49	13720*	11	8.0×10^{-4}**
Electromagnetic valve	62	104160*	4	3.8×10^{-5}**
Tritium room monitor	7	859180	4	4.7×10^{-6}/hr
Tritium process monitor	13	859030	13	1.5×10^{-5}/hr
Hygrometer	9	863800	9	1.0×10^{-5}/hr
Oxygen sensor	7	859180	2	2.3×10^{-6}/hr
Glovebox(GB)	10	1227400	9	7.3×10^{-6}/hr
Master control computer	1	122740	14	1.1×10^{-4}/hr
Negative pressure control of GB	7	758205	5	6.6×10^{-6}/hr
Preheater	5	310989	4	1.3×10^{-5}/hr
Cooling water system	1	122740	16	1.3×10^{-4}/hr
Battery	1	122740	1	8.1×10^{-6}/hr
Heater	3	368220	3	8.1×10^{-6}/hr
Vacuum pump	10	78106	3	3.8×10^{-5}/hr
Flow meter	26	3188640	3	9.4×10^{-7}/hr
Detritiation system	1	96993	1	1.0×10^{-5}/hr
Soft ware of computer	1	122740	12	9.8×10^{-5}/hr

*: Integrated number of times of starting operation

**: Frequency of failure based on the number of times of starting operation

CONCLUSION

1) The TPL has been operated with tritium (60 g) since 1988. Experience of the technology handling a large amount of tritium has been obtained, and no accidental tritium release has been observed since 1988.

2) The safety systems of the TPL have usually functioned since 1988. The detritiation factors of the systems were 20-40 times larger than the design values (10^2-10^4). The design values for the safety systems of ITER (10^2) have thus been demonstrated.

3) The average concentration of tritium in the gas from the stack was 32 Bq/cm^3 from April 1988 to March 2004, which is less than 1/160 of regulation value in Japan.

4) Some significant data for the design and evaluation of tritium systems of fusion facilities have been obtained: the failure frequency and life of components of the tritium systems at the TPL; and the maintenance procedure of the systems.